

U.S. NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment



Industrial Radiography



Introduction



- **Name and Title**
- **How many years with current agency?**
- **Experience in industrial radiography topics?**

10 CFR Part 34

- **First Published in June 1965**
- **1991 NRC Decided to Develop an Overall Revision**
- **Proposed Rule Published February 18, 1994**
- **Final Rule Published May 28, 1997**
- **Rule Effective Date June 27, 1997**
- **Delayed Implementation**

NOTE: Copies of 10 CFR Part 34 are provided for the class on CD and in bound volumes.



Definitions

Industrial Radiography (Radiography)

- **Means an examination of the structure of materials by nondestructive methods, utilizing ionizing radiation to make radiographic images.**

Radiographic Operations

- Means all activities associated with the presence of radioactive sources in a radiographic exposure device during use of the device or transport (except when being transported by a common or contract transport), to include surveys to confirm the adequacy of boundaries, setting up equipment, and any activity restricted area boundaries.

Permanent Radiographic Installation

- An enclosed shielded room, cell, or vault, not located at a temporary jobsite, in which radiography is performed.

Field Station

- A facility where licensed material may be stored or used and from which equipment is dispatched.

Location of Use

- **Specific location identified on the license where material is stored or used, may or may not be where the licensee does not dispatch from (e.g. permanent radiographic installation, field stations, and storage locations).**

Temporary Jobsite

- **A location where radiographic operations are conducted and where licensed material may be stored other than those location(s) of use authorized on the license.**

10 CFR Part 34

- **Regulatory requirements for industrial radiography license.**
- **Specific elements which the applicant must submit, are as follows:**

Elements of an Application

- **Training**
- **Affirmation that users are certified**
- **Operating and Emergency procedures**
- **6-month job performance inspection**
- **Organizational structure (chart) and delegation of authority and responsibility**
- **Qualifications for RSO and potential designees**

Elements of an Application

- **Identify and describe the location(s) of all field stations and permanent radiographic installations**
- **Identify the location of all Part 34 records**
- **Optional: Perform leak tests & analysis:**
 - **Procedures to perform tests and analysis**
 - **Qualification of person conducting test/analysis**
 - **Instruments used**
 - **Methods of performing the analysis**

Elements of an Application

- **Optional: Perform instrument calibration:**
 - **Procedures must implement § 34.25**
 - **Experience of person performing calibration**
 - **Frequency must implement § 34.25 (6 months or after servicing, except battery change)**

NUREG-1556 VOL. 2

“Program-Specific Guidance About Industrial Radiography Licenses”

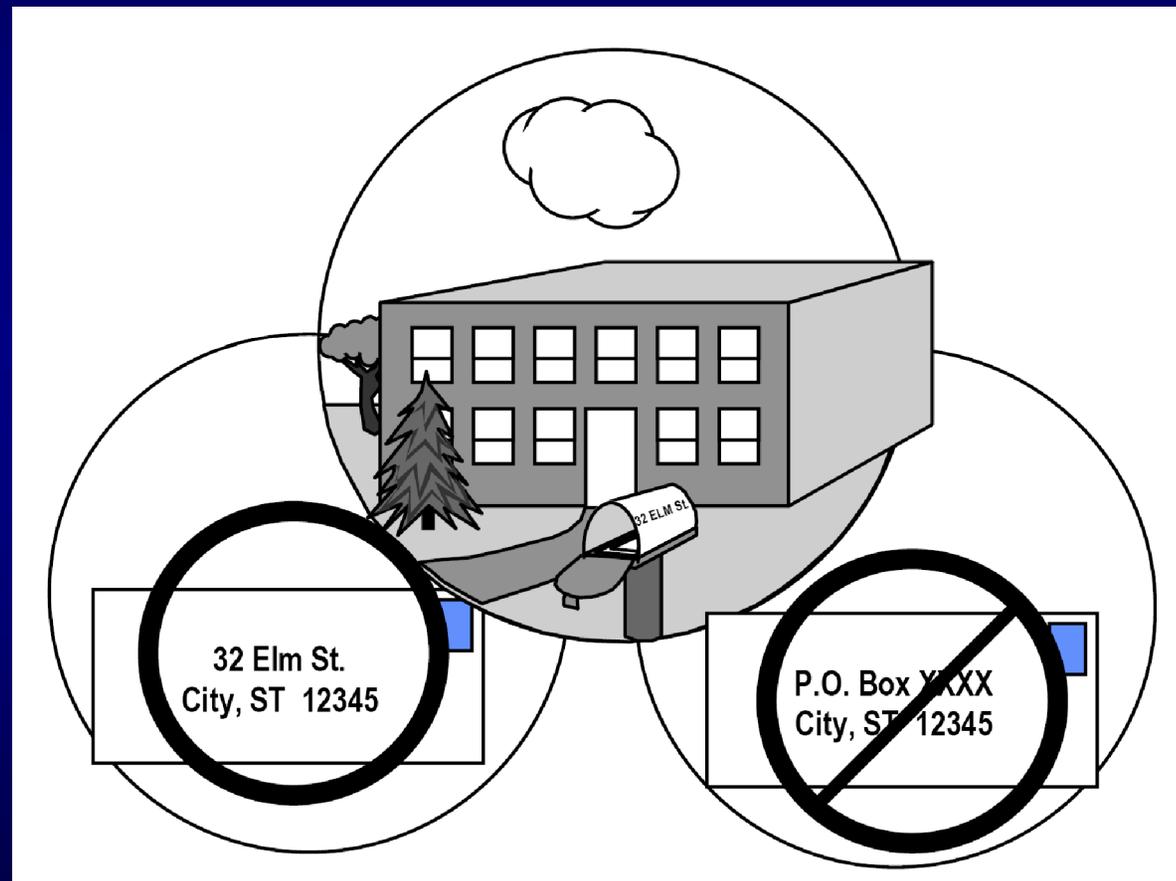
Action Type

- **New License**
- **Amendment to License**
- **Renewal to License**

Name and Mailing Address

- Legal Name of corporation or legal entity
- A division or department within a legal entity may not be a licensee
- Individual acting in private capacity
- Mailing address

Location of Use



Addresses Where Licensed Material Will be Dispatched, Used, Stored or Possessed

- **Permanent Radiographic Installation(s)**
- **Locations outside of permanent radiographic installations**
- **Field Station(s)**
- **Location outside of field stations**
- **Temporary Jobsites**

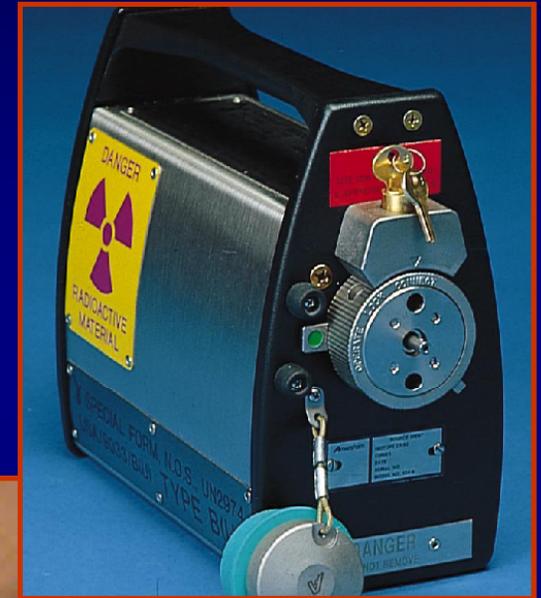
Contact Person

- **Individual who can answer questions about the application.**
- **Telephone number**
- **RSO or Knowledgeable Management Official**

Sealed Sources and Devices Radiography

- **Identify radionuclides that will be used**
- **Confirm that each sealed source, device, and source/device combination possessed is registered by NRC or an Agreement State**
- **Confirm that all radiographic exposure devices, source assemblies, or sealed sources and associated equipment satisfy 10 CFR 34.20**

Sealed Source/Device/ Source Changer Combination



Pipeliner Devices

- **NOTE: The NRC does not authorize pipeliner devices. A pipeliner device is one that is directly connected to the pipe and does not have the “S” tube. The source is attached to a rotor. It was used on offshore platforms in close work proximity and currently in some Agreement States. The device does not meet the performance requirements in § 34.20.**



Sample License – License Condition 10

<u>Isotope</u>	<u>Manufacturer & Model No. of Source Assemblies</u>	<u>Maximum Activity per Source</u>	<u>Manufacturer & Model No. of Exposure Devices</u>	<u>Manufacturer & Model No. of Source Changers</u>
A. Ir-192	CIS-US, Inc. Model 702	120 curies	AMSHM Model 660 System, and Models 660A, 660AE, 660B, 660BE	AMSHM Model 650L, SPEC Model C-1
B. Ir-192	AMSHM Model A424-9 or A424-22, SPEC Models T-5 or T-5F, IN Model 7	140 curies	AMSHM Model 660 System, and Models 660A, 660AE, 660B, 660BE	AMSHM Models 650L, 820, or 855, SPEC Model C-1, IN Model IR-50
C. Se-75	AEAT/QSA Model A424-25W	80 curies	AMSHM Model 660 System, and Models 660A, 660AE, 660B, 660BE, AEAT/QSA Model 880 Delta	AMSHM Model 650L
D. Co-60	AMSHM Models A424-14 or 943	110 curies	AMSHM Model 680 System and Models 680A, 680AE, 680B, 680BE	AMSHM Models 770, 771

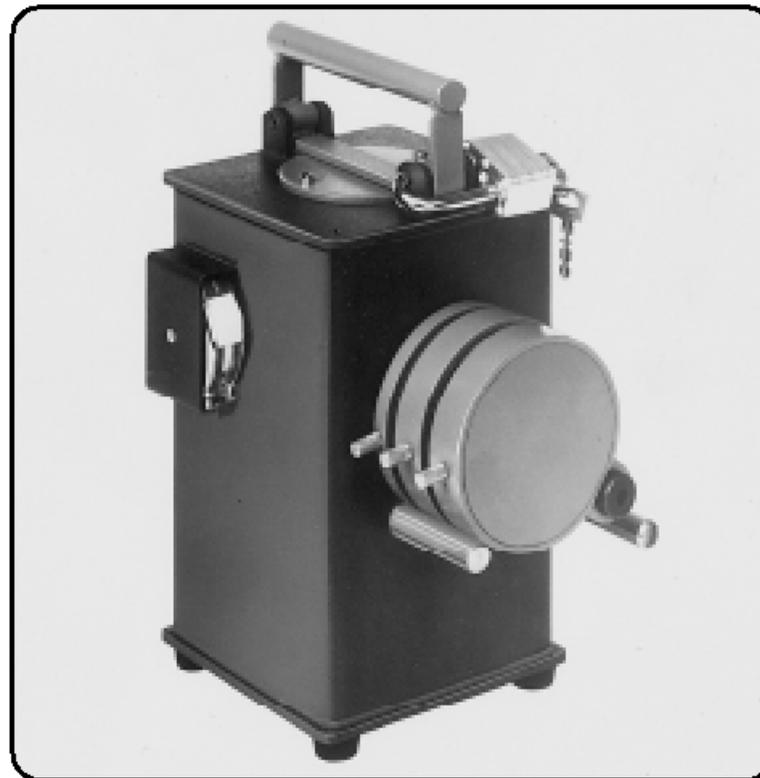
Other Sealed Sources Nonradiographic Uses

- **Identify radionuclides that will be used - survey instrument calibrator, pocket dosimeter calibrator**
- **Identify any depleted uranium (DU) that is used**
- **Tattletales & X-Ray crawlers**

Instrument Calibrator

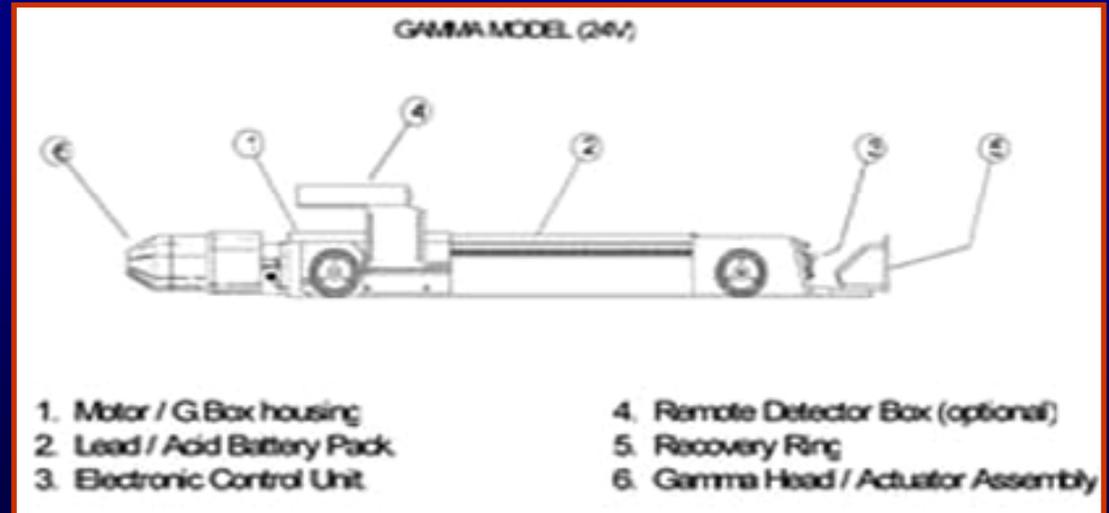
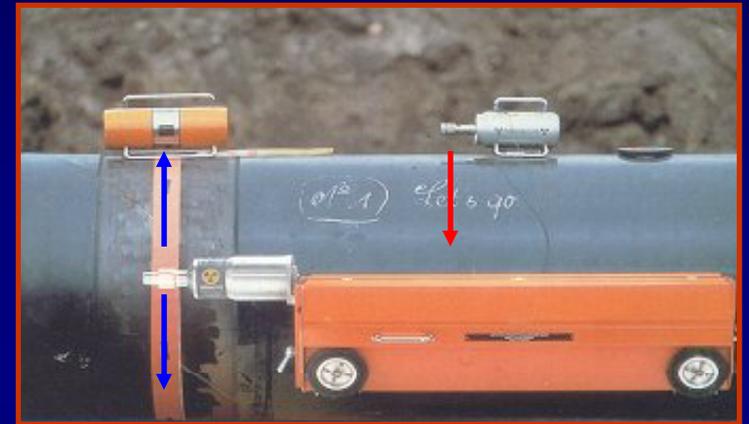
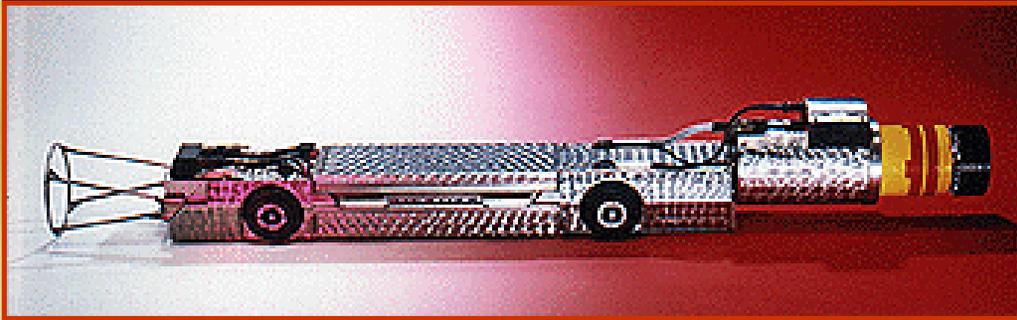
Model 64-773NAD

Gamma Survey Instrument Calibrator



Gamma Survey Instrument Calibrator with three attenuators in place

Pipeline X-Ray Crawlers



Use of Licensed Material

- **Industrial radiography**
- **Off-shore platform radiography**
- **Lay-barge radiography**
- **Underwater radiography**
- **Uses other than radiography (survey instrument calibrators)**

Off-Shore Platform



Shell's Auger TL Platform

Laybarge Radiography



Sample License - Other Radionuclides and Authorized Use Items 6, 7, 8, & 9

6.	Byproduct, source, and/or special nuclear material	7.	Chemical and/or physical form	8.	Maximum amount that licensee may possess at any one time under this license
A.	See Condition 10	A.	Sealed sources	A.	See Condition 10
B.	Cesium-137	B.	Sealed sources (AEA Model 77302)	B.	Not to exceed 200 millicuries per source
C.	Gadolinium-153	C.	Sealed sources (Amersham Model GDC.CY1)	C.	Not to exceed 1.0 curie per source
D.	Depleted Uranium	D.	Shielding material	D.	8,000 kilograms

9. Authorized use:
- A. For use in industrial radiography and replacement of sources.
 - B. For use in Amersham Model 773 instrument calibrator for calibration of licensee's survey instruments required by 10 CFR Part 34.
 - C. For use in a Lixi, Inc. Model LS-80X or LS-82X for non-medical fluoroscopy.
 - D. For use in shielding in radiography equipment.

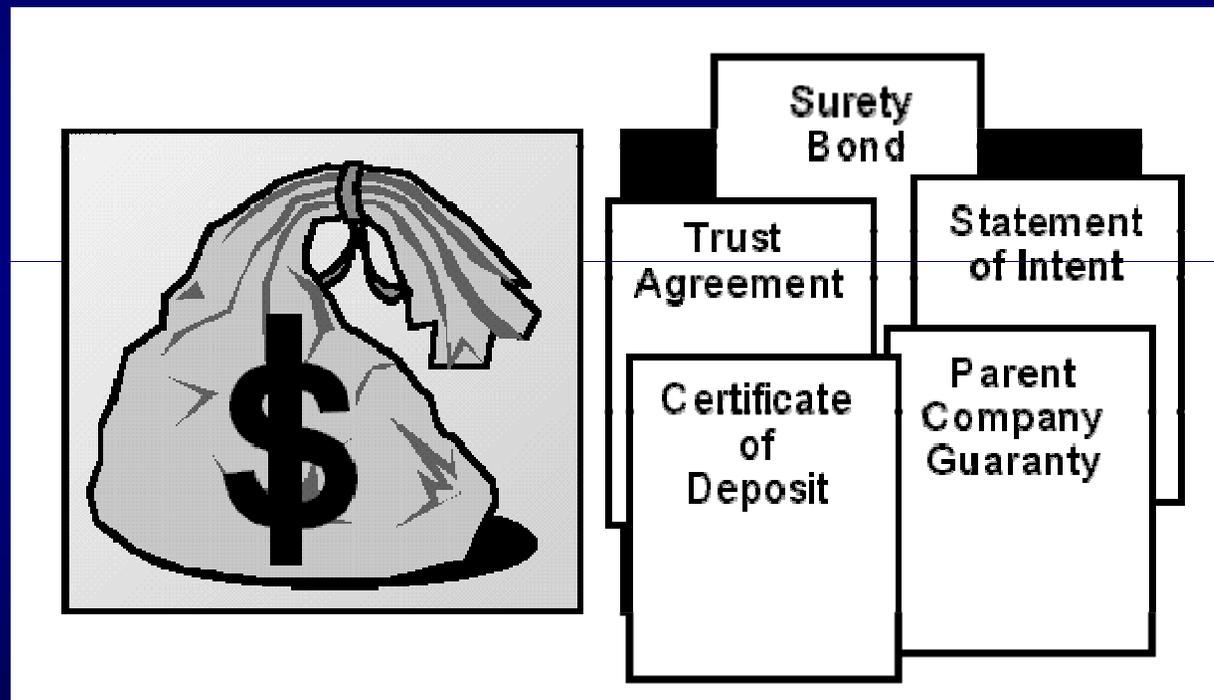
Financial Assurance

Cobalt-60	10,000 Curies (sealed)
Iridium-192	100,000 Curies (sealed)

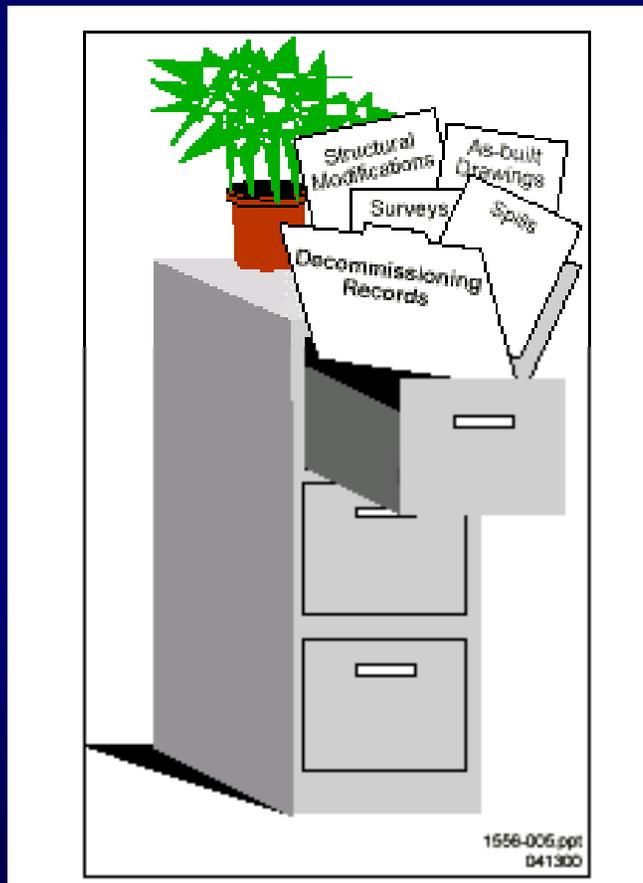
Example License Condition limitation:

The licensee shall restrict the possession of licensed material to quantities below the minimum limit specified in 10 CFR 30.35(d), 40.36(b), and 70.25(d) [70.25(d) optional if known applicant/licensee will not be using SNM] for establishing financial assurance for decommissioning.

Financial Assurance Methods



Decommissioning Records



Recordkeeping Requirements for Decommissioning

- **Identified location**
- **As-built drawings showing modifications to structures and equipment**
- **Sketch of rooms, buildings, or narrative description of the area**
- **Unusual occurrences (leaking source or other incidents that involve contamination)**
- **Does not apply to temporary jobsites**

Radiation Safety Officer

- **Means an individual with the responsibility for the overall radiation safety program on behalf of the licensee and who meets the requirements of 10 CFR 34.42**

Radiation Safety Officer Qualifications

- **Certified Radiographer**
- **2,000 hours (one year full-time experience with hands-on experience as a radiographer)**
- **Formal training in establishing and maintaining a radiation safety program (basic radiation safety course is NOT acceptable)**

Radiation Safety Officer Alternate Qualifications

➤ **Certified Health Physicist**

or

➤ **Certified Industrial Hygienist**



Radiation Safety Officer Alternate Qualifications

- **Appropriate training & experience in the field of ionizing radiation (e.g., certifications or completion of bachelor's and/or master's degree in science)**
- **One year experience in managing a radiation safety program of comparable size and scope**
- **Formal training in establishing and maintaining a radiation safety program**

Radiation Safety Officer Effectiveness

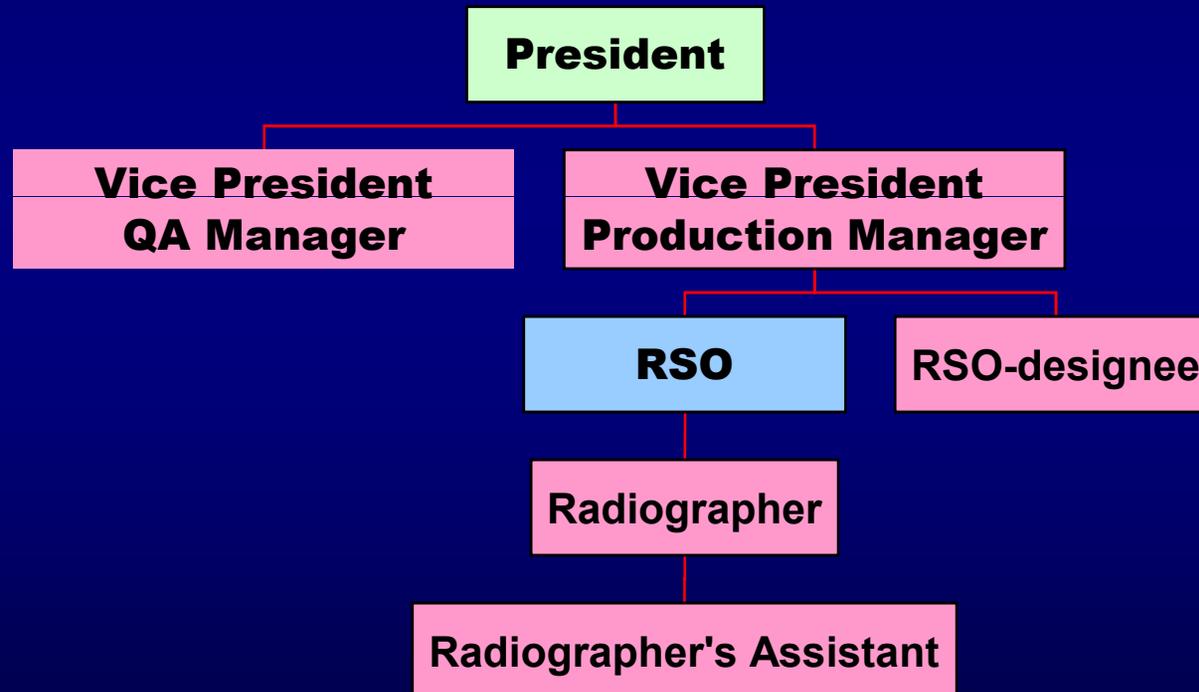


Radiation Safety Officer Effectiveness

- **RSO has sufficient independence and direct communications with management**
- **Sufficient time & commitment**
- **Provide a copy of an organizational chart by position, demonstrating day-to-day oversight**

Radiation Safety Organization Chart

Mo Rad, Inc.



RSO Duties & Responsibilities



Stop Unsafe Licensed Activities



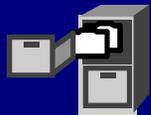
Monitor Emergency Events



Proper Use and Maintenance



Device Security



Records, Receipt and Accountability, Maintenance Calibration, etc.



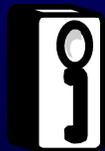
Personnel Training



**Annual Worker Audits
Annual Program Audit**



Interaction with NRC



**Equipment, Survey Meters,
Personnel Dosimetry,
Calibrations, etc.**



Material Disposal



Transportation

Radiation Safety Officer Designee

- **Individual who may “step-in” as an emergency contact when the RSO is unavailable.**

Radiation Safety Officer Designee

- **The applicant identifies and lists the qualifications of the individual(s) designated as the RSO and potential designees responsible for ensuring that the licensee's radiation safety program is implemented in accordance with approved procedures.**

Radiation Safety Officer Designee

- **Appropriate training & experience in the field of ionizing radiation**
- **Experience in managing a radiation safety program**
- **Formal training in establishing and maintaining a radiation safety program**

Radiographer

- **A person who performs or personally supervises industrial radiography and is responsible for ensuring compliance with NRC regulations and the safe use of radioactive materials.**
- **A certified radiographer is an individual who has been certified by a certifying entity that he/she has met established radiation safety, testing, and experience criteria.**

Appendix G

- **Ensure training in 10 CFR 34.43(g) topics**
- **On-the-Job Training - 2 months or 320 hrs**
- **Certification by a Certifying Entity**
- **Receive copies of and instructions in NRC Regulations, the NRC license, and the licensee's operating and emergency procedures (approximately 8 hours training):**
 - **10 CFR 34 30.7, 30.9, and 30.10**
 - **Applicable Parts of 10 CFR 19 and 20**
 - **Applicable DOT Regulations and 10 CFR 71**
 - **The NRC License**
 - **Operating and Emergency Procedures**

Appendix G

- **Written or Oral Examination**
 - **50 questions**
 - **80% Minimum Passing Grade**
- **Receive Equipment Training**
- **Demonstrate Understanding by Passing Practical Exam**
- **Annual Refresher Training**

Radiographer's Assistants

- An individual, who under the direct supervision (in the physical presence) of the radiographer uses radiographic equipment (sealed sources containing byproduct material or related handling tools, exposure devices, and radiation survey instruments) in performing industrial radiographic operations.

Appendix G

- **Receive copies of and instructions in NRC Regulations, the NRC license, and the licensee's operating and emergency procedures (approximately 8 hours training):**
 - **10 CFR 34, 30.7, 30.9, and 30.10**
 - **Applicable Parts of 10 CFR 19 and 20**
 - **Applicable DOT Regulations and 10 CFR 71**
 - **The NRC License**
 - **Operating and Emergency Procedures**

Appendix G

- **Written Examination**
 - **25 to 50 questions**
 - **Closed Book**
 - **80% Minimum Passing Grade**
- **Receive Equipment Training**
- **Demonstrate Understanding by Passing Practical Exam**
- **Annual Refresher Training**

Facilities and Equipment

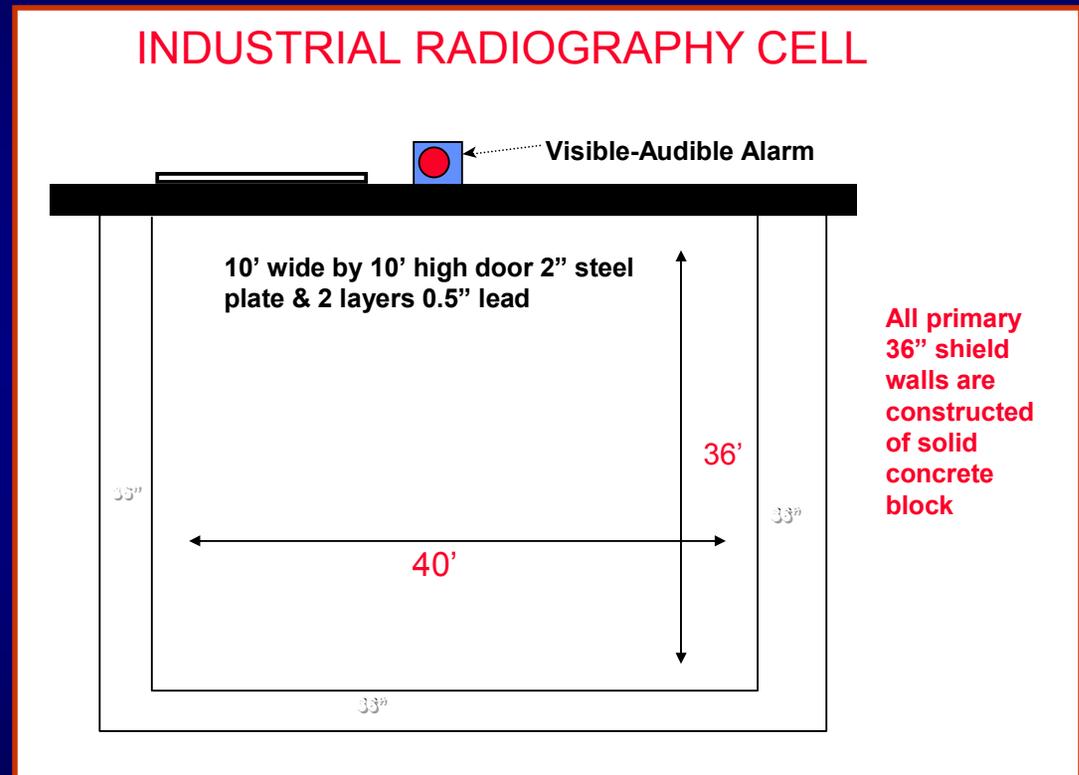
- **Permanent Radiographic Installation**
- **Places of Use at Locations Identified on the License**
- **Field Stations (storage, use and dispatch from)**
- **Temporary Jobsites**

Permanent Radiographic Installations

- An enclosed shielded room, cell, or vault, not located at a temporary jobsite, in which industrial radiography is performed.

Permanent Radiographic Installations

- ▶ Annotated sketch or drawing
- ▶ Scale of drawing
- ▶ Type and thickness of shielding
- ▶ Location of entranceways or points of access
- ▶ Areas adjacent to the facility
- ▶ Description of visible-audible signal system



Permanent Radiographic Installations

- **Private residence information**
- **No residential quarters**
- **Unrestricted Areas**
- **Calculations or actual radiation measurements made above, below, and adjacent to the facility**
- **Unrestricted areas < 100 mrem per year**

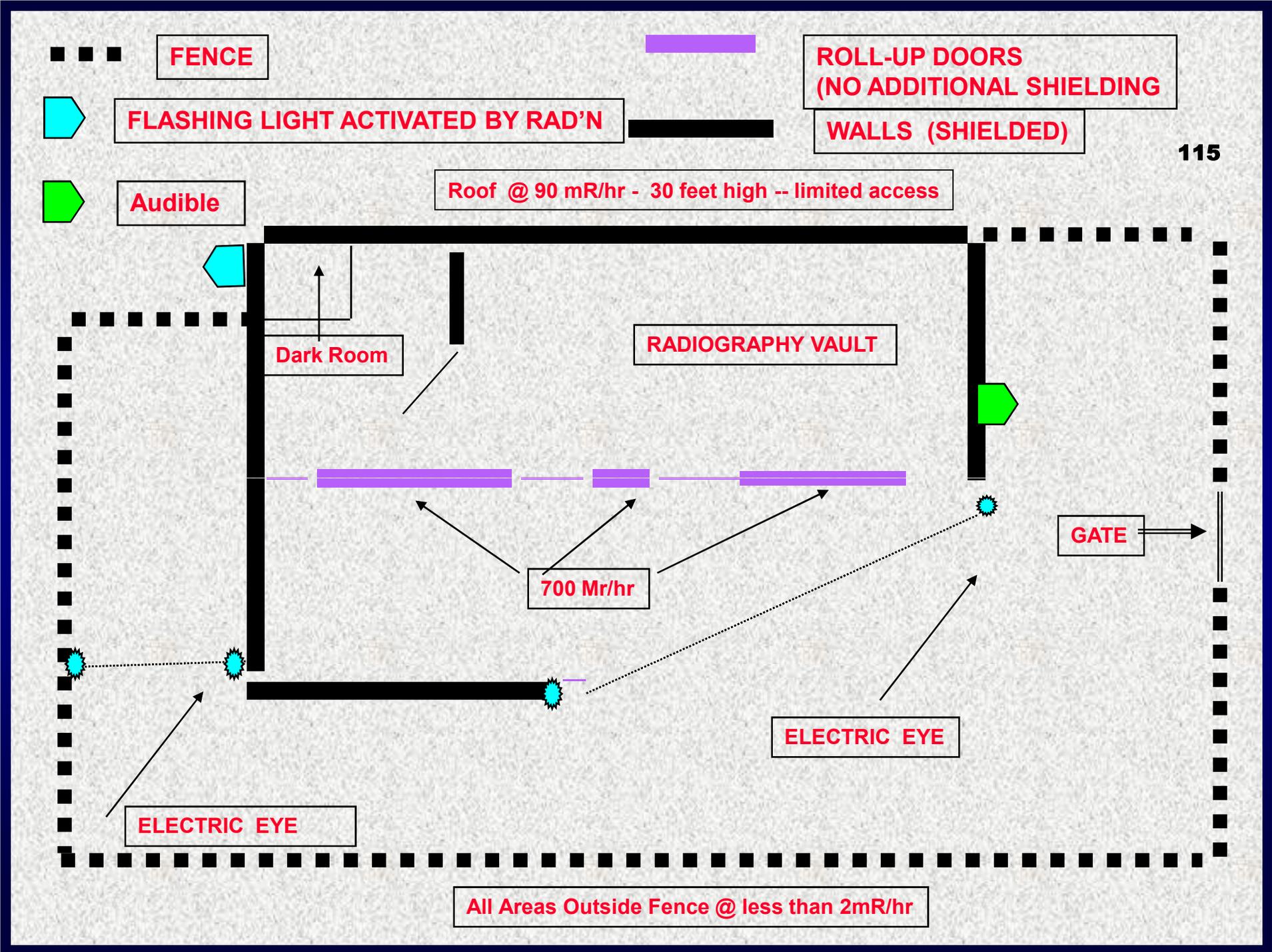
Permanent Radiographic Installation - Roof Variance

- **Means of Access to Roof**
- **Administrative Access Procedures**
- **Posting**
- **Steps to minimize radiation on roof**

Permanent Radiographic Installation

Variance when radiation levels exceed
100 mrem in any one hour

- **Commitment to post as required per 10 CFR Part 20**
- **Constant Surveillance by TV Monitor**
- **Dose Rate Variance**
- **Automatic Control Devices**
- **Automatic Activation of Visible-Audible Signal**



Places of Use at Locations Identified on the License

- **All radiographic operations conducted at locations of use authorized on the license must be conducted in a permanent radiographic installation, unless specifically authorized by the Commission (listed on the license)**

Field Station

- **A facility where licensed material may be stored or used and from which equipment is dispatched.**

Field Station

- **Describe the storage location**
- **Submit a diagram**
- **Radiography performed outside of the field station or permanent radiography installation**
- **Submit a diagram of the location “as if work was conducted in the field”**

Temporary Jobsite

- **A location where radiographic operations are conducted and where licensed material may be stored other than those location(s) of use authorized on the license.**

Annual Radiation Safety Audit

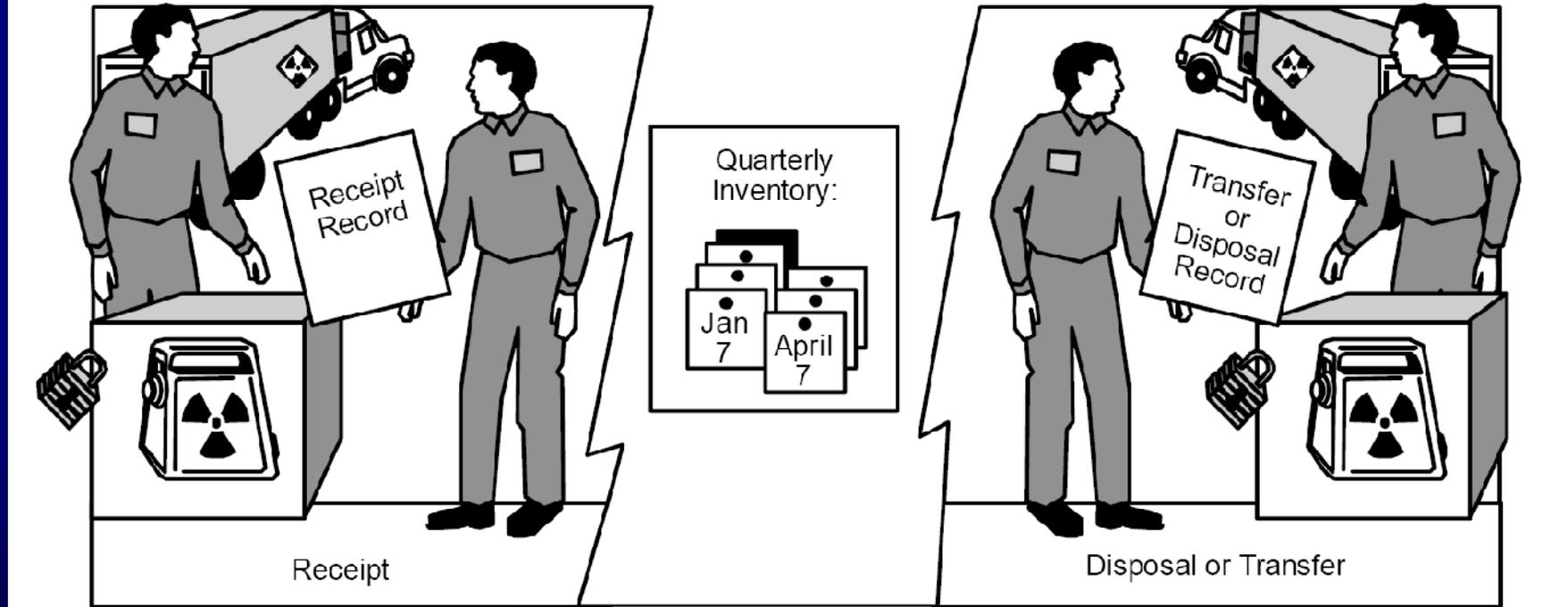
- **10 CFR 20.1101(c)**
- **The licensee shall periodically (at least annually) review the radiation protection program content and implementation**
- **Guidance may be found in Appendix I of NUREG-1556, Volume 2**
- **No response is required during a licensing phase**

Survey Meter Calibration

- Use instruments which are calibrated
- Calibration performed by NRC or Agreement State Licensee
- In-house calibration in accordance with [Appendix J](#) or describe alternative procedures
- Personnel Qualifications
- Authorized by license condition

Material Receipt and Accountability

Cradle to Grave Accountability



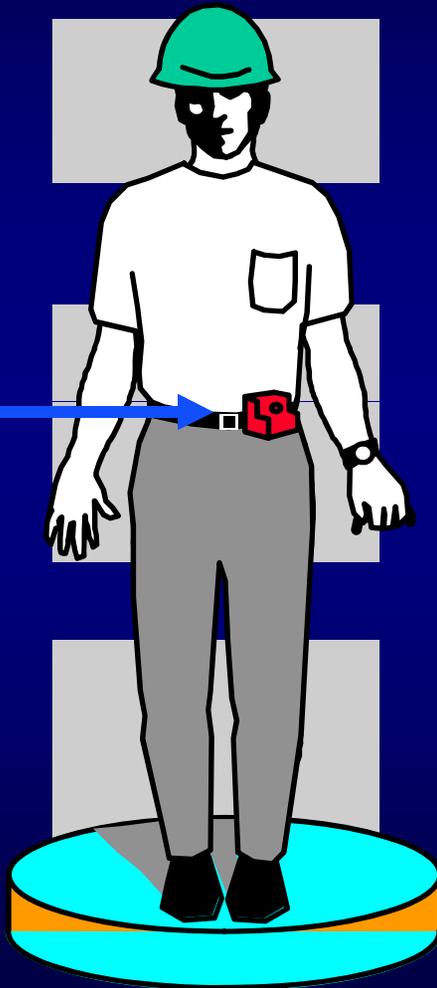
Material Receipt and Accountability

- **Maintain records of receipt, transfer, and disposal of sources/devices**
- **Conduct physical inventories at quarterly intervals (not to exceed 3 months) to account for all sealed sources containing byproduct material and devices containing depleted uranium.**

Leak Tests

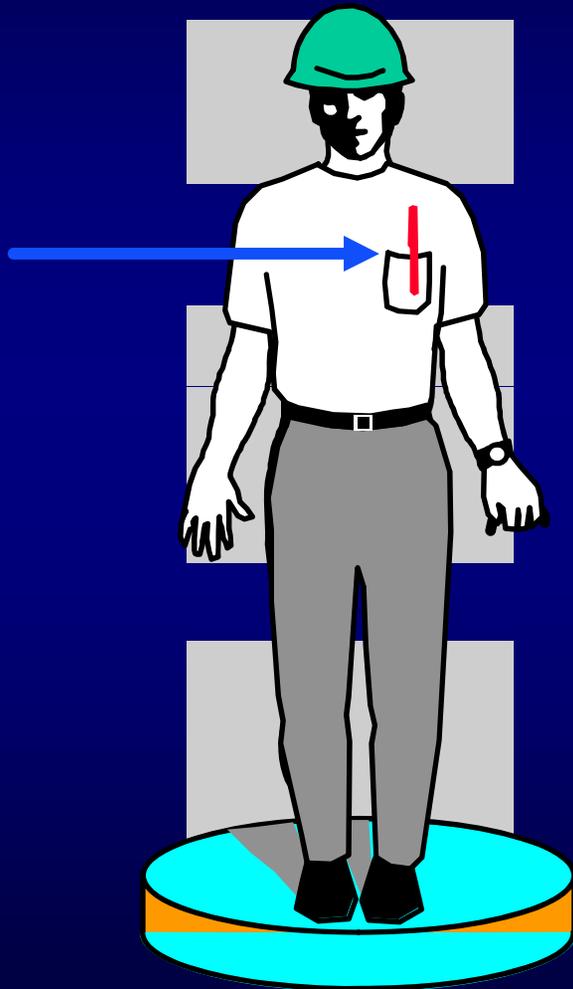
- **Organization licensed by NRC or Agreement State**
- **Using Leak Test Kit provided by an organization licensed by NRC or an Agreement State**
- **In house by applicant using procedures in Appendix K or describe alternatives**
- **Authorized by license condition**

Personnel Dosimetry



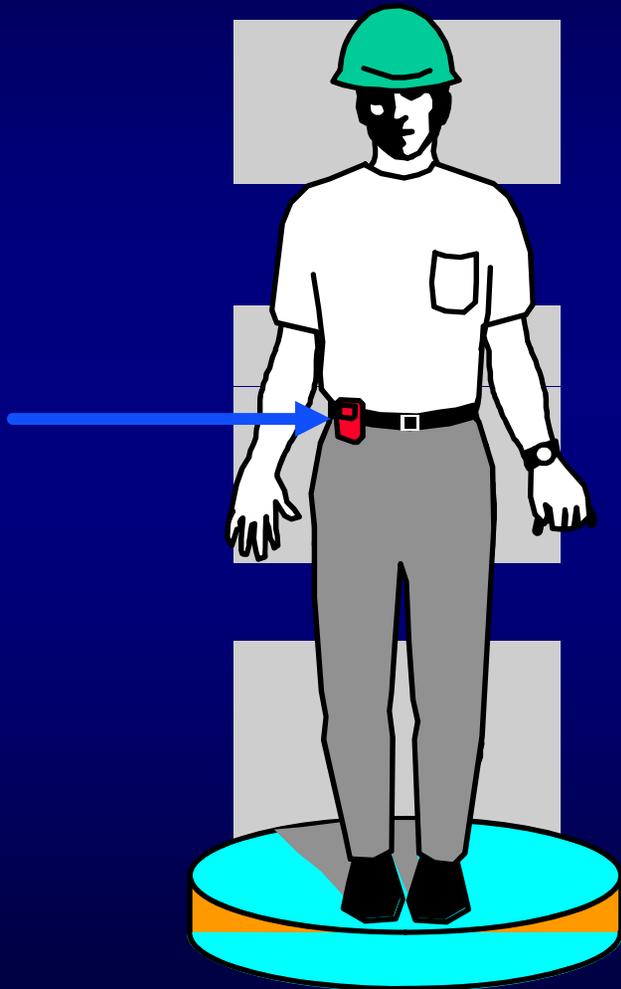
- **Filmbadge**
- **TLD**
- **OSL**
- **NVLAP - Approved**
- **Exchange Frequency**

Pocket Dosimeter



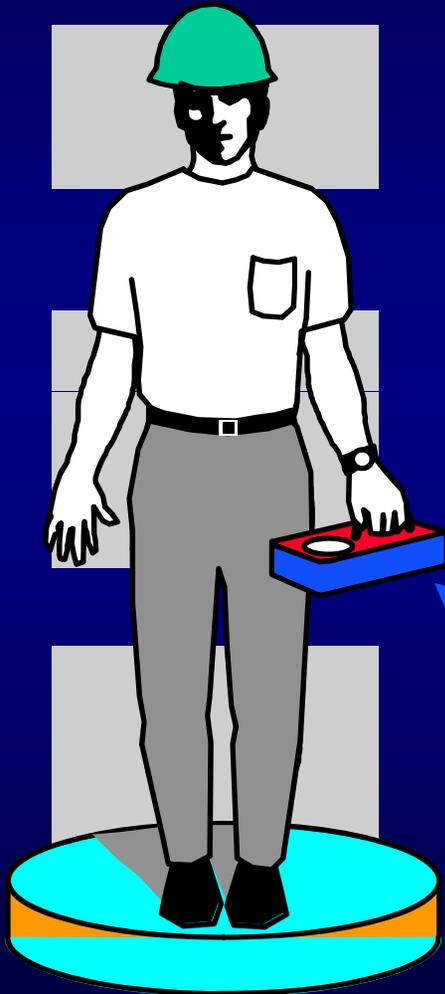
- **Pocket Dosimeter (may include electronic dosimeter)**
- **Range of 0-200 millirem**
- **Annual Calibration**
- **Charge and Zero at the beginning of each shift**

Alarming Ratemeter



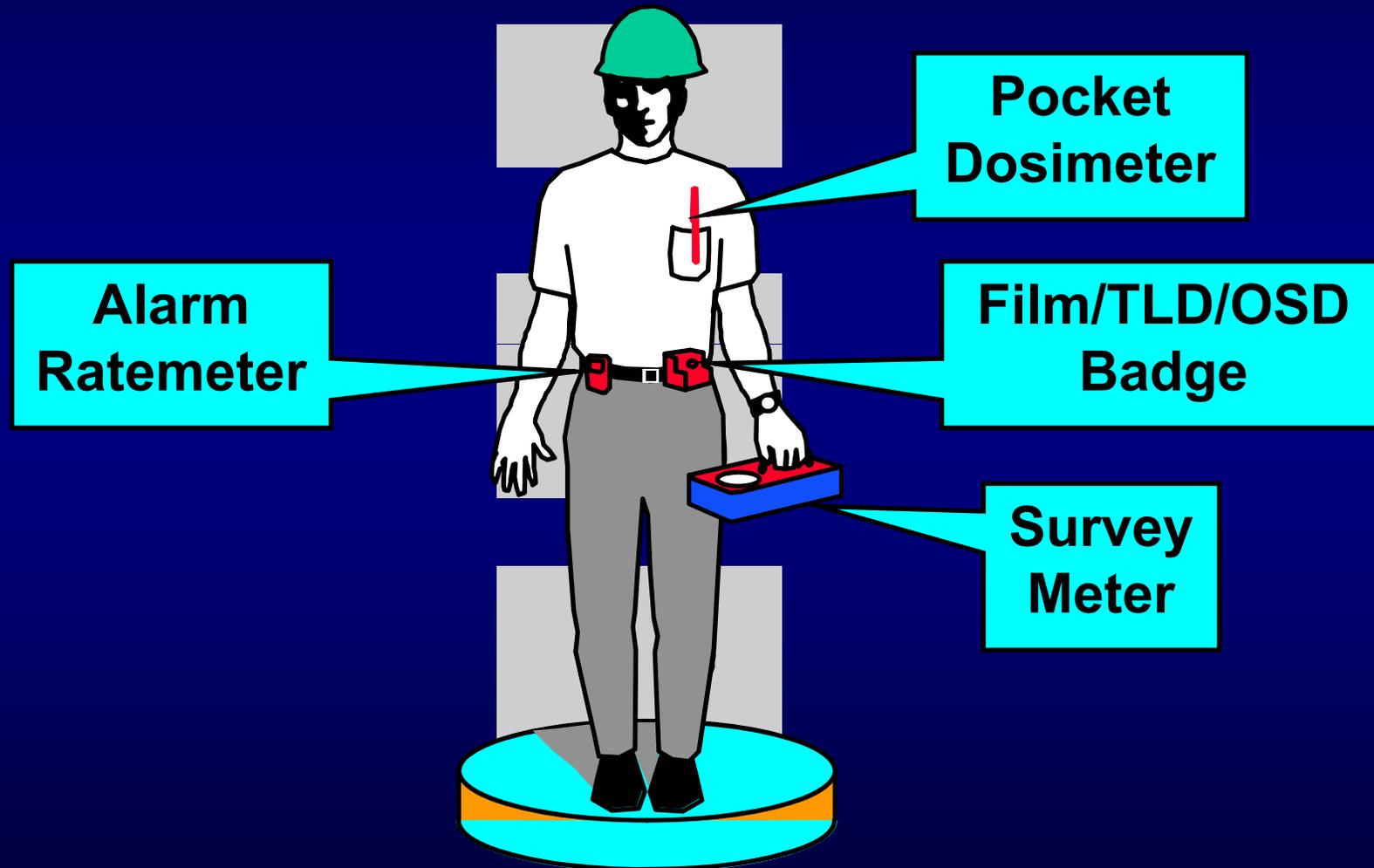
- **Alarming Ratemeter**
- **Fixed alarm @ $\pm 20\%$ of 500 millirem**
- **Check Alarm Function before each shift**
- **Annual Calibration**

Survey Meter



- **Calibrated @ 6-month frequency**
- **Range from 2 millirem up to 1R**

The Well-Dressed Radiographer

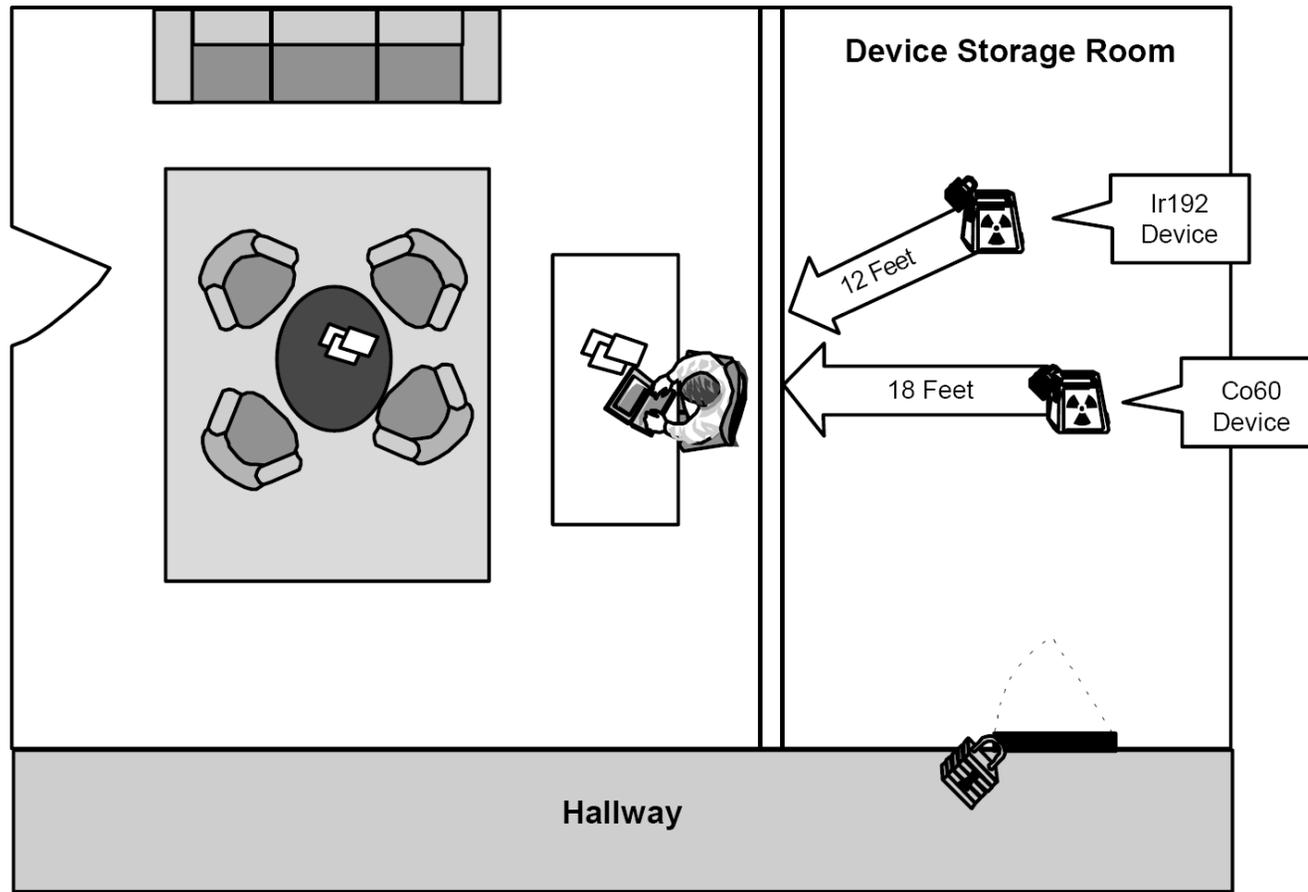


Off-Scale Dosimetry

- **Stop work immediately**
- **If alarm sounds check pocket dosimeter**
- **Follow Emergency Procedures**
- **Notify RSO or RSO designee of the problem**
- **Do not resume operations until authorized by RSO or RSO designee**
- **If exposure cannot be rule out dosimeter must be processed within 24 hours**
- **Submit O&E Procedures for rate meter alarms and off-scale dosimetry**

Public Dose Assessment

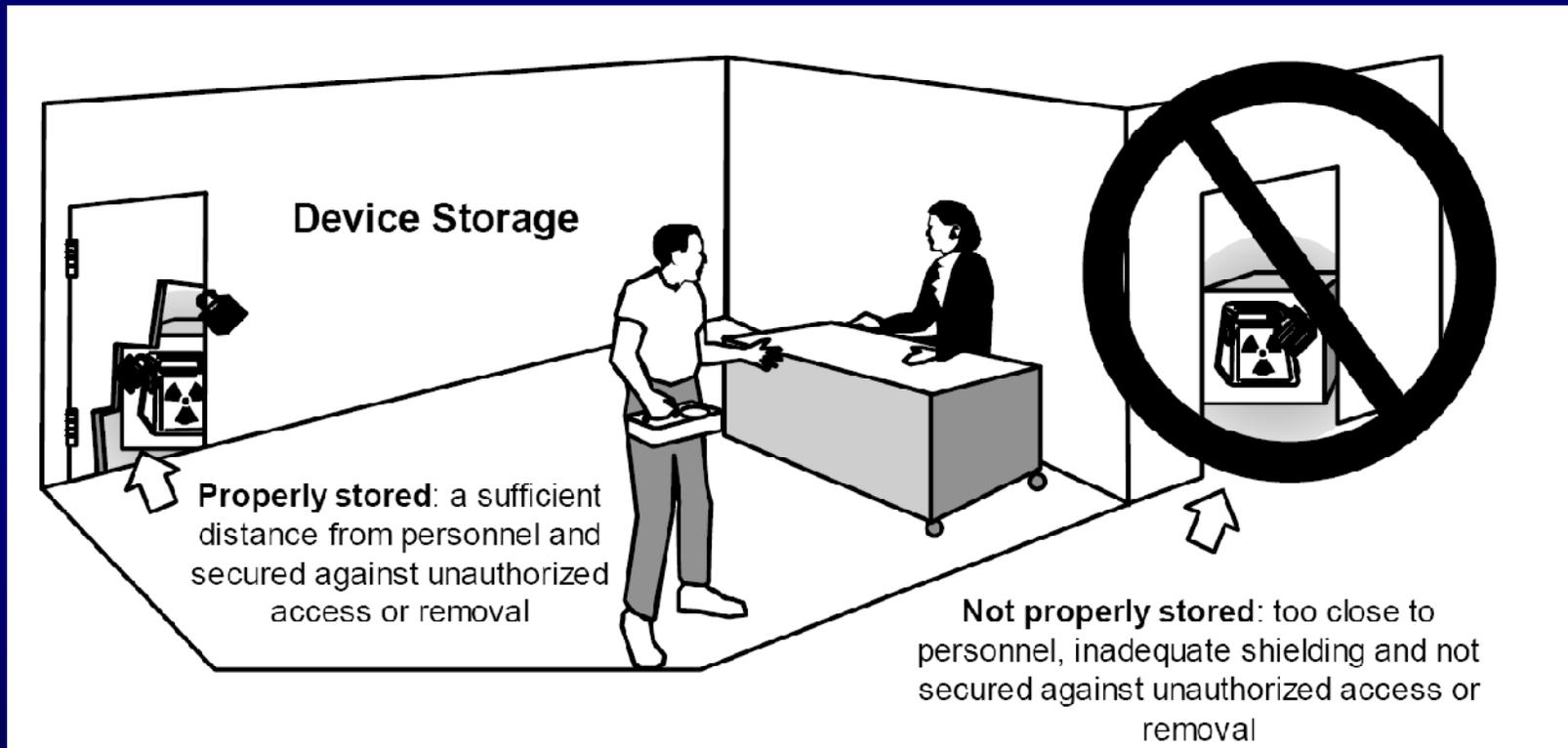
A Bird's Eye View of Office and Device Storage Area



Quarterly Maintenance

- **Submit for NRC review**
- **Before using a new sealed source/device combination, we will have written inspection and maintenance procedures and provide training to radiography personnel**

Storing Devices



Handling and Use

- **Step-by-Step Instructions for each type of radiography device**
- **Instructions for Source Exchange**
- **See [Appendix M](#)**

O & E for Special Types of Industrial Radiography

- **Transport**
- **Storage**
- **Access Control**
- **Unique Radiation Safety Procedures**
- **Special Equipment and Use Restrictions**
- **Unique Inspection & Maintenance**
- **Unique Emergency Procedures**

Radiation Surveys

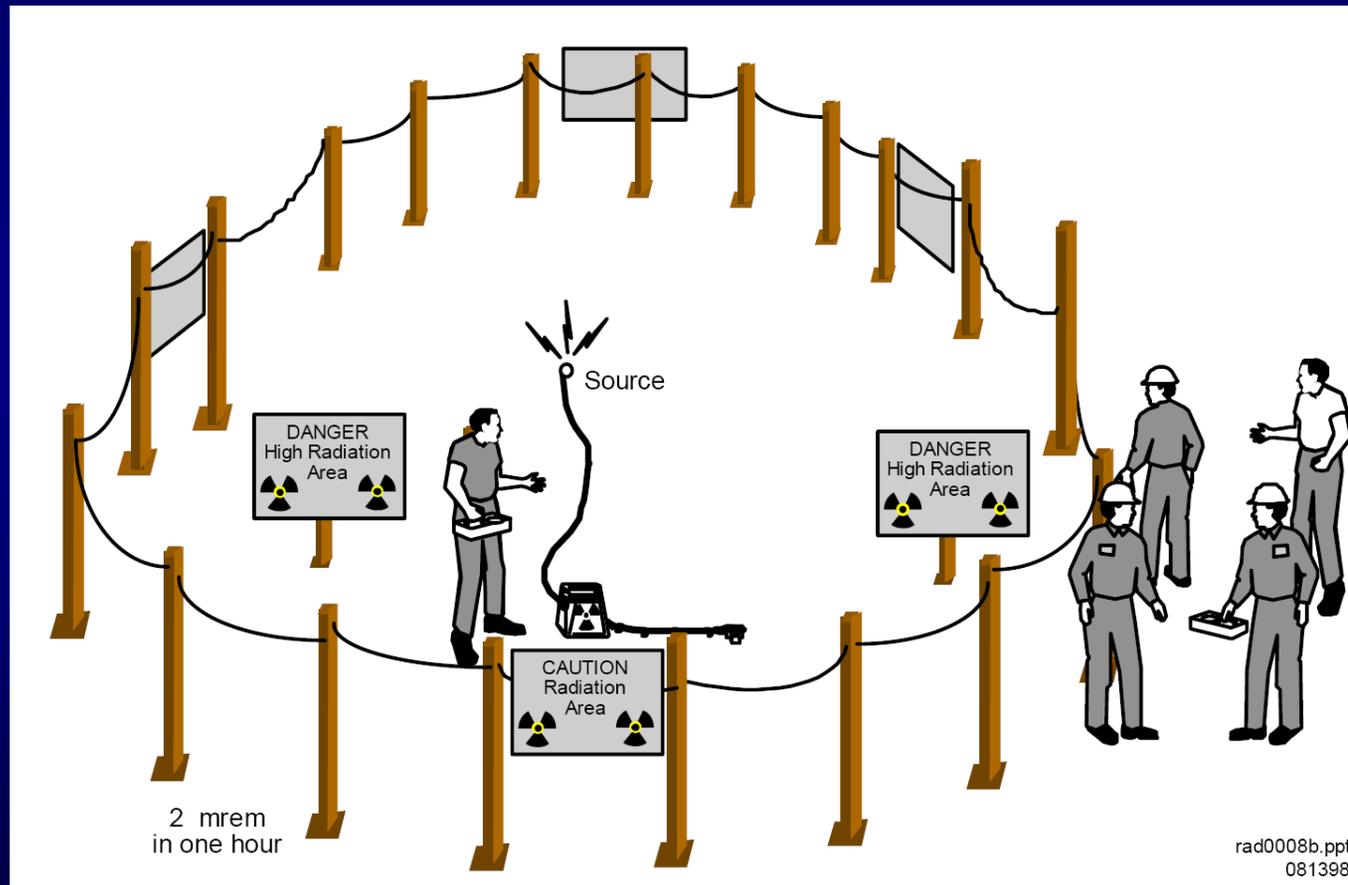
- **Table 8.5 (next slide) is a table of all the surveys required for radiographic operations**
- **Ensure the Operating and Emergency Procedure(s) include these required surveys**

**(see NUREG 1556
Volume 2, page 8-32)**

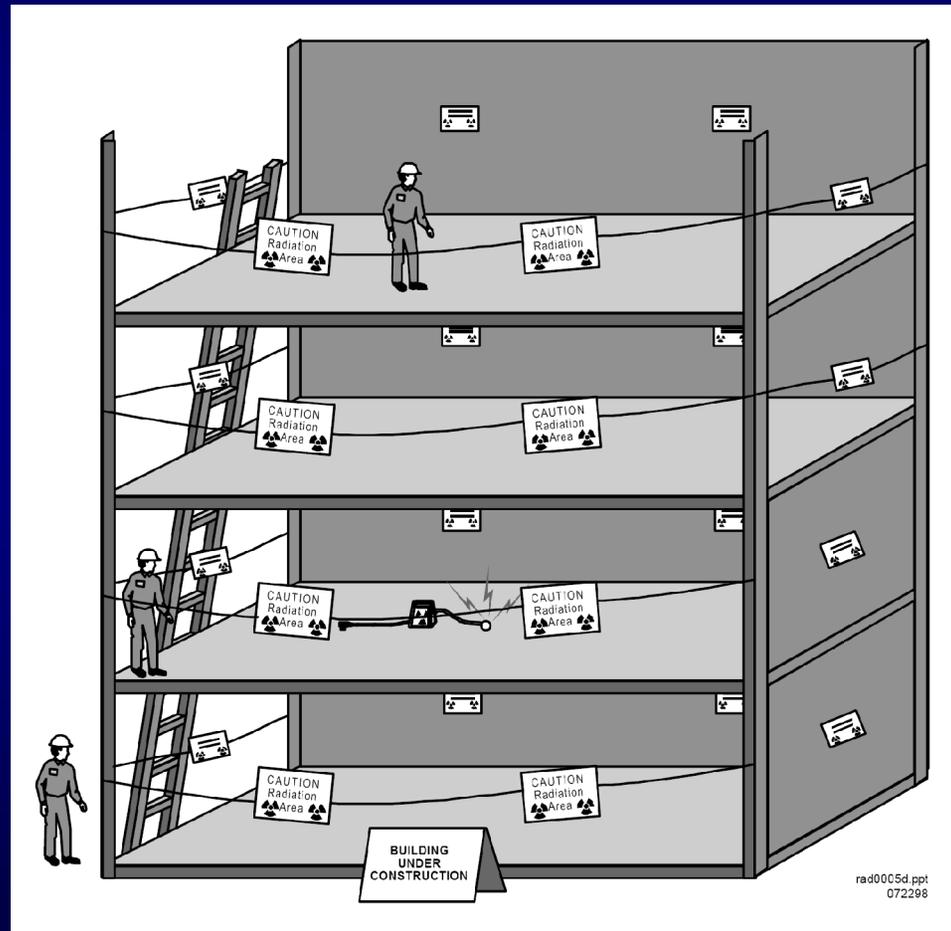
Table 8.5 Surveys Required for Radiographic Operations

Requirement	Frequency	Type of Radiation Survey
10 CFR 20.1301(a)(2)	During the first exposure for each set up of radiographic device	Boundary of restricted area at temporary jobsite does not exceed 0.02 mSv (2 mrem) in any one hour
10 CFR 20.1302(a)(1)	At intervals not to exceed 12 months	Unrestricted area in vicinity of permanent radiographic installation or storage area does not exceed 1 mSv (100 mrem) per year
10 CFR 20.1906	Each receipt of package	External radiation levels when a package is received and opened
10 CFR 34.20(a)	Each installation of new source in exposure device	Exposure rate does not exceed 2 mSv/hr (200 mrem/hr) on surface and 0.1 mSv/hr (10 mrem/hr) at one meter
10 CFR 34.21	Each installation of new source in a storage container or source changer	Exposure rate does not exceed 2 millisieverts (200 millirem) per hour at any exterior surface, and 0.1 millisieverts (10 millirem) per hour at 1 meter from any exterior surface with the sealed source in the shielded position.
10 CFR 34.27(c)(1)	At intervals not to exceed 6 months	Contamination level for leak tests of sealed sources does not exceed 185 Bq (0.005 microcuries)
10 CFR 34.27(e)	At intervals not to exceed 12 months	Contamination level for leak tests of S tube of exposure device does not exceed 185 Bq (0.005 microcuries)
10 CFR 34.49(b)	After every radiographic exposure	Confirm source has returned to a shielded position
10 CFR 34.49(c)	After every source exchange or exposure device is placed in storage	Confirm source is in shielded position
49 CFR 172.403	Every movement of licensed material on public roads	Exposure rates meet labeling of package (i.e., Yellow II) and determine Transportation Index
49 CFR 173.441	Every movement of a package labeled Yellow III	Exposure rates in and around vehicle do not exceed 0.002 mSv/hr (2 mrem/hr) in driver's seat, 2 mSv/hr (200 mrem/hr) on surface and 0.1 mSv/hr (10 mrem/hr) at 2 meters from vehicle

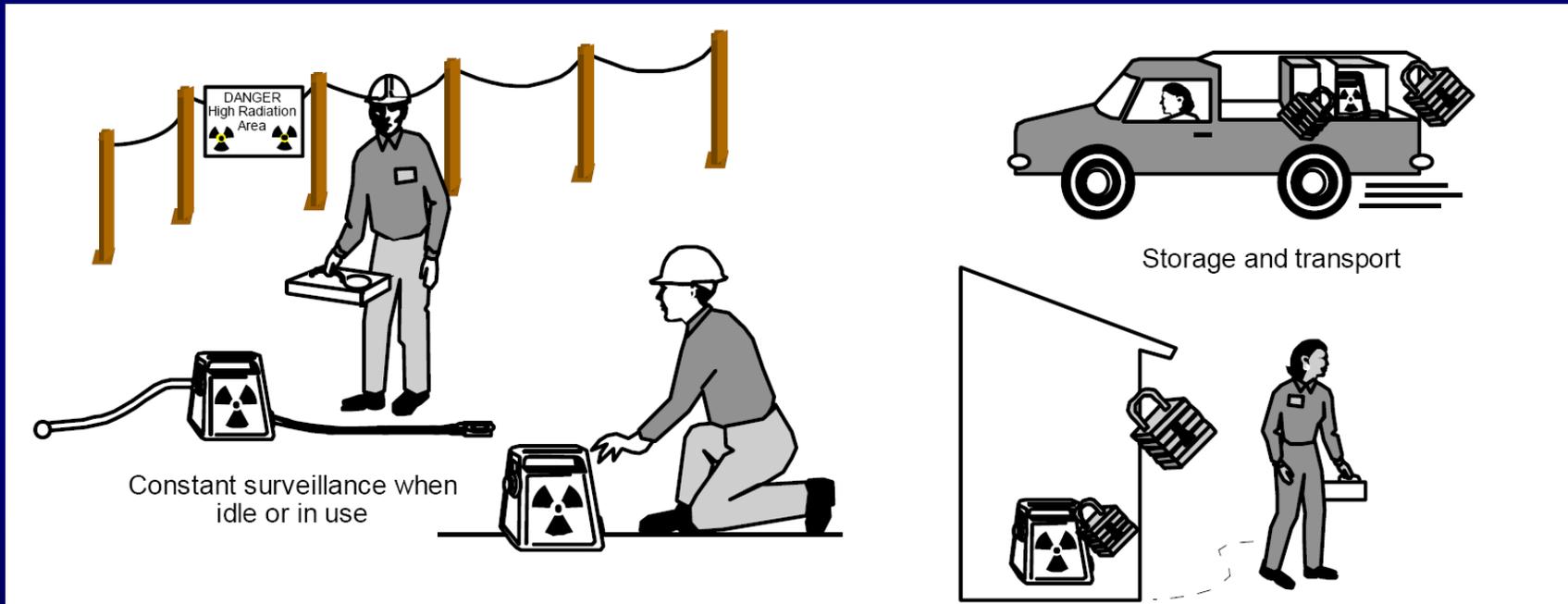
Controlling Access Radiographic Areas



Posting and Surveillance with Multiple Floors



Security of Radioactive Material



Increased Controls

- Issued November 14, 2005.
- Implementation by May 13, 2006 - 1st set of orders sent out.
- Implementation by June 20, 2006 - 2nd set of orders sent out.
- Orders are Publicly Available except the list of licensees who received the orders.
- Radiography licensees received the orders.

Increased Controls

- **Ensure new radiography licensees receive the Order, until Part 73 is updated, and complete implementation before taking possession of the Table 1 Quantities of Concern.**
- **Must attend Security Training to inspect the licensees who received Increased Controls (ICs).**

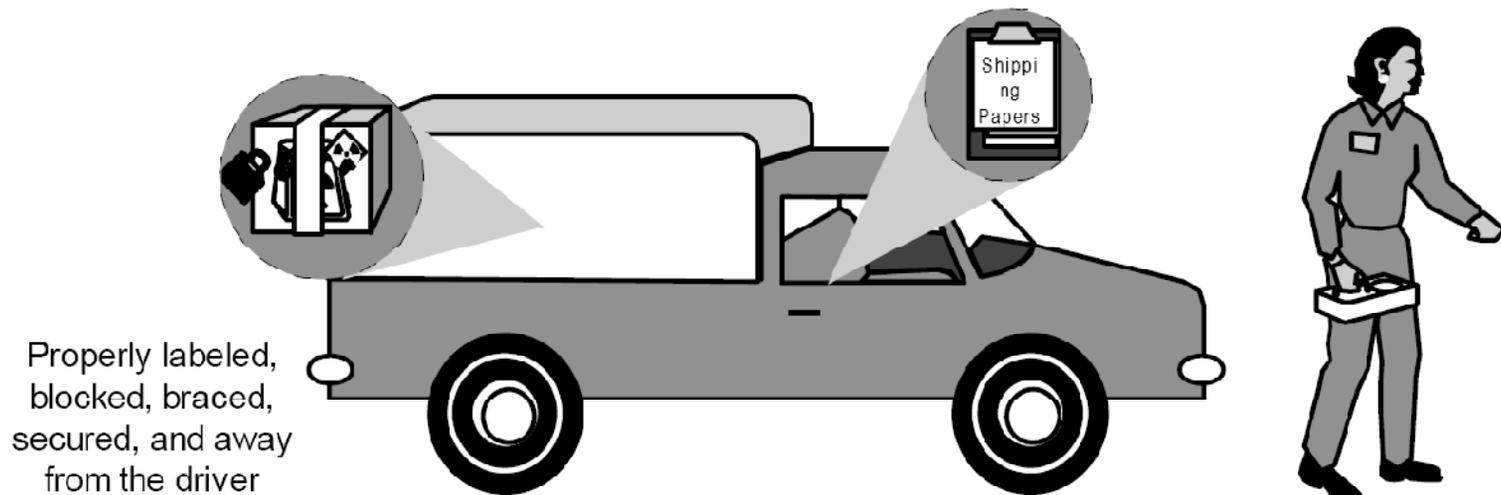
Quantities of Concern

Radionuclide	Activity (Curies)
Ir-192	22
Co-60	8.1
Se-75	54

- **The aggregate activity of multiple, collocated sources (unity rule) can not exceed one.**
- **Breaching one common physical security barrier to allow access to the material ~ then all material in that one location is considered collocated.**

Transportation

Transportation



Daily Maintenance Check of Radiographic Equipment

- See Appendix O

Daily Inspection & Maintenance

- **Submit O & E Procedures for Daily Inspection and Maintenance**

10 CFR Part 21 Defects

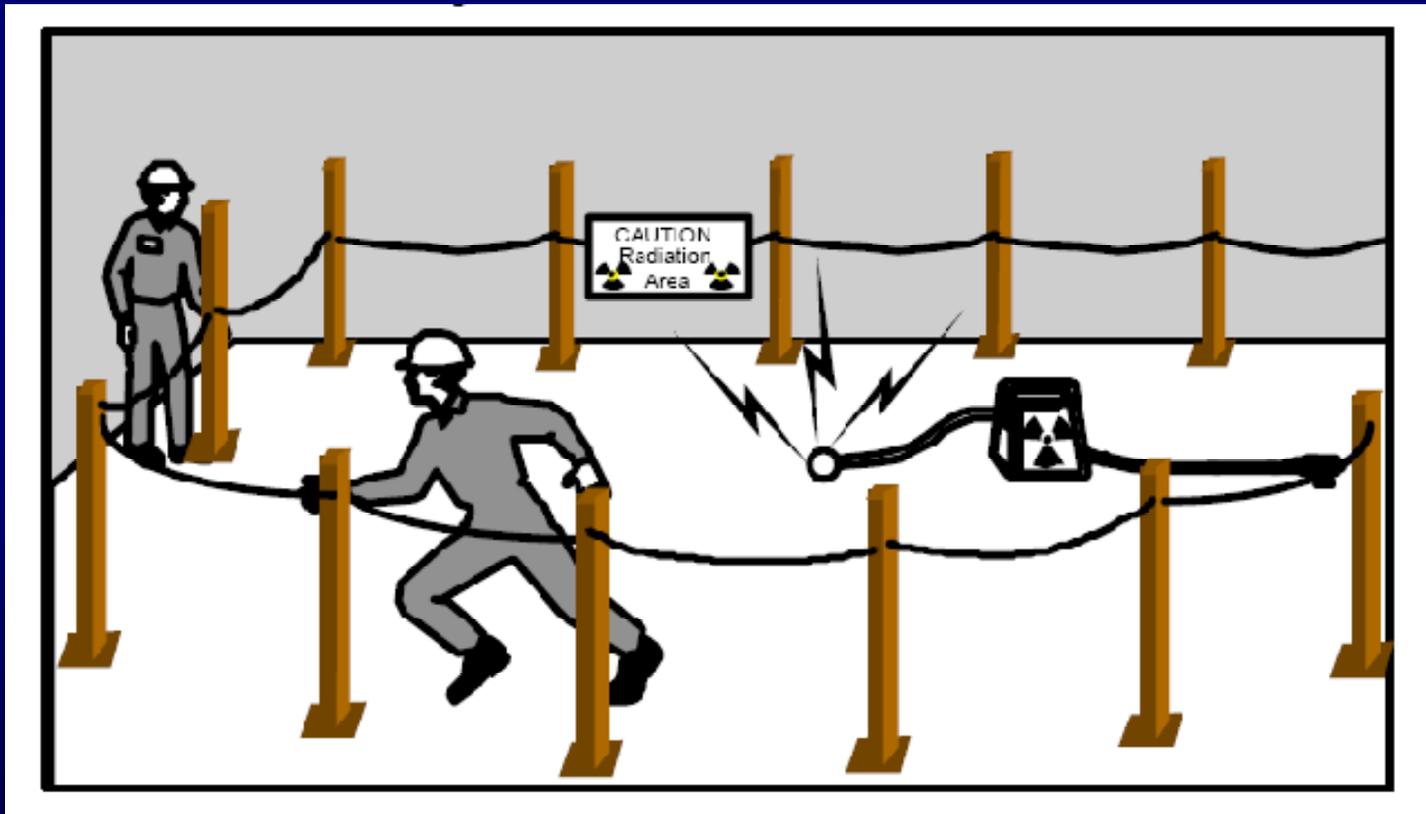
- **Submit O&E Procedures for notifying management and subsequently the NRC of equipment malfunction or defect**

Notifications

- **Table 8.6 is a table of typical NRC notifications**
- **Operating and Emergency Procedures must ensure that appropriate notifications are made during and after an emergency**

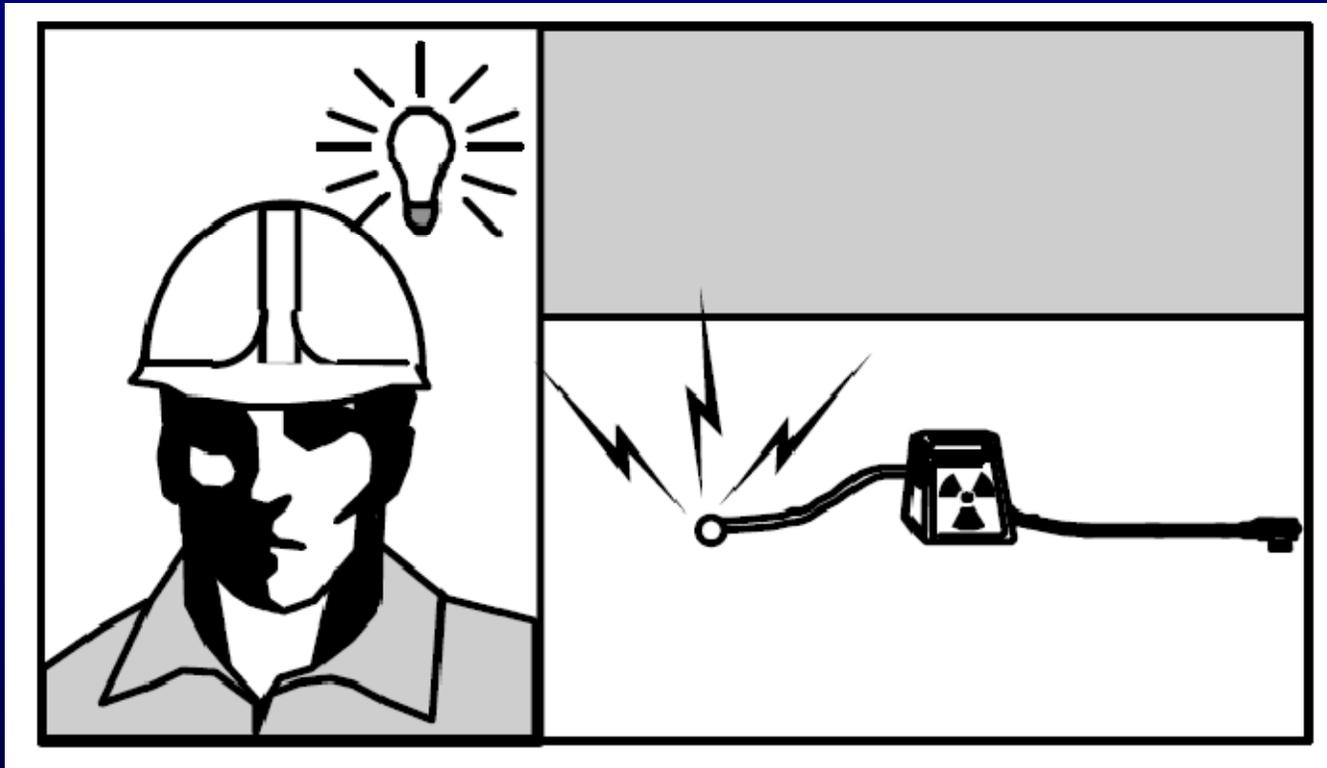
Emergency Procedures

Immediately move away from the source



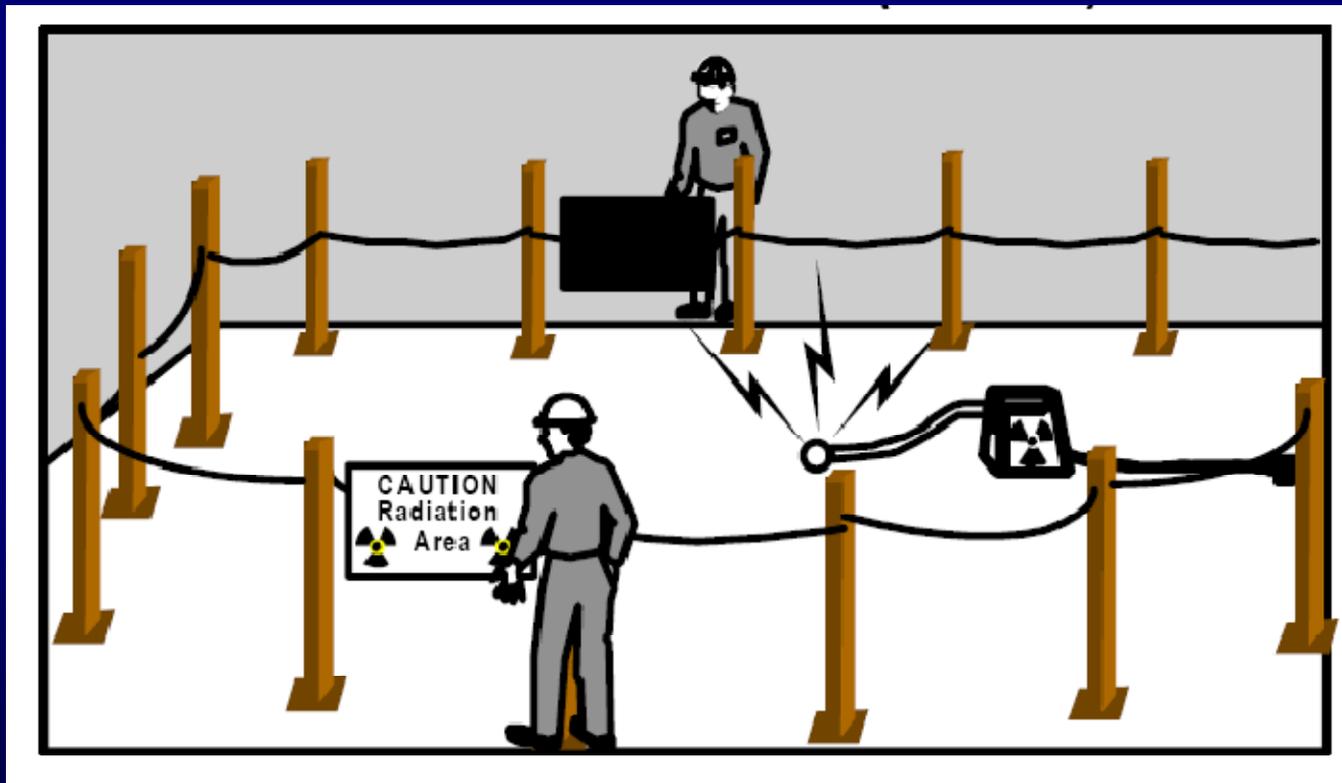
Emergency Procedures

THINK!



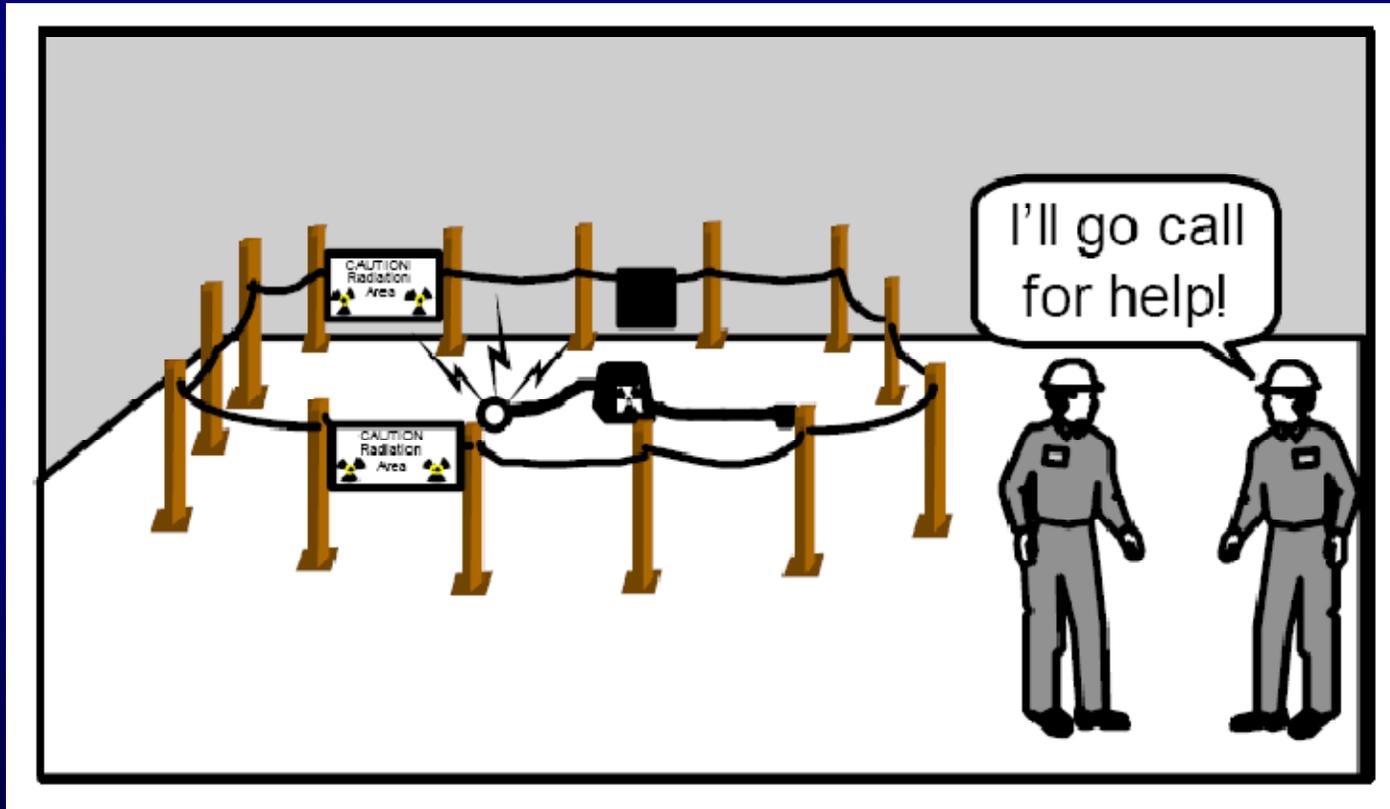
Emergency Procedures

Confirm 2 millirem in any one hour



Emergency Procedures

Go for HELP!!!



Emergency Procedures

Call the RSO or RSO Designee



Source Retrieval

- **Submit procedures**

OR

- **A statement that the licensee will not perform source retrievals**

Source Retrieval Procedures

- Only specific individuals
- Do not handle source, etc.
- Methods of dose reduction
- Additional dosimetry
- Access Control
- Use correct survey instruments
- Criteria for outside assistance
- Notification of RSO
- Specific training with tools
- Notify NRC/Agreement State

Records

- **Utilization Logs**
- **Daily Inspections**
- **Pocket Dosimeter Readings**
- **Physical Surveys**
- **Inspection & Maintenance**
- **Radiation Safety Instrument Calibrations**
- **Audit Records**
- **Record Keeping Requirements addressed in O & E Procedures**

Waste Management

- **Transfer to Authorized Recipient**
- **Company, Legal Entity, or Individual licensed by NRC/AS to receive material**
- **Commercial Burial Ground**
- **Waste Management Vendor**

Transfer of Control

- **10 CFR 30.34(b)**
- **Mergers**
- **Contractual Agreements**
- **Buyouts**
- **Majority Stock Transfer**
- **NUREG 1556, Vol. 15, Appendix F**



THE END